US-PAT-NO: 6536653

DOCUMENT-IDENTIFIER: US 6536653 B2

TITLE: One-step bumping/bonding method for forming
semiconductor packages

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Abstract Text - ABTX (1):

A one-step bumping/bonding process for forming a semiconductor package is disclosed. In the method, a first electronic substrate which has either a plurality of conductive pads or a plurality of recessed openings formed on top of a plurality of apertures through the substrate is first provided and aligned with a second electronic substrate that has a plurality of conductive pads with each aperture aligned to a conductive pad on the second substrate. A plurality of solder balls is then planted on top of the plurality of conductive pads or the plurality of recessed openings on the surface of the first electronic substrate by a pick-and-place technique. Alternatively, a plurality of solder paste may be printed by a thick film **stencil** printing process similarly in place of the plurality of solder balls. After a solder reflow process, the solder balls placed on top of the apertures is reflown into the apertures forming solder plugs and making electrical connection with the conductive pads on the second electronic substrate thus completing the one-step bumping/bonding process for forming a semiconductor package. The electronic substrate may be either a printed circuit board or a silicon wafer.

Brief Summary Text - BSTX (28):

The one-step bumping/bonding process for forming semiconductor packaging may further include the step of providing the first electronic substrate in a silicon wafer and providing the second electronic substrate in a printed circuit board, or the step of forming the first plurality of apertures by laser drilling or by micro-electro-mechanical-system machining. The depositing step for the solder bump may be carried out by a thick film printing or by a **stencil** printing technique. The method may further include the step of reflowing the solder bump at a temperature higher than a reflow temperature of the solder material, or the step of depositing solder flux onto the first plurality of conductive pads prior to the solder bump depositing step. The method may further include the step of coating a sidewall in the first plurality of apertures with an adhesion promoter prior to depositing the solder bump.

Drawing Description Text - DRTX (15):

FIG. 8 is an enlarged, cross-sectional view of the present invention electronic substrate positioned on top of a second electronic substrate and having a plurality of solder bumps **stencil** printed on a top surface.

Detailed Description Text - DETX (3):

In the method, the one-step bumping/bonding for forming semiconductor packages can be carried out by first providing an electronic substrate that has either a first plurality of recessed openings or a first plurality of conductive pads formed on a first surface insulated from each other by a first insulating material layer, then forming a first plurality of apertures through

the first electronic substrate, the first plurality of recessed openings or conductive pads, and the first insulating material layer with one aperture formed corresponds to each conductive pad, then providing a second electronic substrate that has a second plurality of conductive pads formed on a second surface insulated from each other by a second insulating material layer, the first plurality may be equal to or different from the second plurality, one of the electronic substrates is a silicon wafer, while the other electronic substrate is a printed circuit board. The step for forming the first plurality of apertures may be accomplished by a technique such as laser drilling, micro-electro-mechanical-system machining, or other suitable method. A solder ball or a solder bump may be deposited onto either the plurality of conductive pads or the plurality of recessed openings by a technique of either pick-and-place or **stencil** printing, respectively.

Detailed Description Text - DETX (14):

As shown in FIG. 8, a plurality of solder bumps 100 and 102 is formed on top of the first electronic substrate 50. The solder bumps 100,102 may be suitably formed by a thick film printing, or a **stencil** printing process in a low cost fabrication method. A solder paste containing Pb and Sn is normally used which also contains a solvent as a binder. The paste, when mixed with suitable viscosity or consistency, can be easily **stencil** printed on top of the electronic substrate 50 at selected locations, i.e. over the apertures 64 or on top of the conductive pads 60.

Detailed Description Text - DETX (15):

In a partial, enlarged, cross-sectional view shown in FIG. 9, the solder

bump 102 is placed on top of a flux layer (not shown) and a conductive pad 60,
while solder bump 100 is placed directly on a conductive pad 60. After a
solder reflow process is conducted at a suitable reflow temperature, such as
just above the melting point of the solder material, the solder bump 102 flows
into apertures 64 by a capillary effect in forming solder plugs 104 and making
electrical connection with conductive pads 72 situated on the second electronic
substrate 70. This is shown in FIG. 10. The solder bumps 100 on top of the
conductive pads 60 also reflow into solder balls 106 after the reflow process.
The present invention one-step bumping/bonding process is thus completed by the
formation of the solder plugs 104 from the solder bump 102. It should be noted
that, in this third preferred embodiment, the amount of solder bump 100,102
formed on top of the first electronic substrate 50 can be suitably adjusted by
changing the hole dimensions in the **stencil** during the **stencil** printing
process.

Claims Text - CLTX (23):
23. A one-step bumping/bonding process for forming semiconductor packaging
according to claim 20, wherein said depositing step for said solder paste being
carried out by a thick film printing or by a **stencil** printing technique.